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ABSTRACT

The following articles on athletics in the Soviet Union are edited and translated for American readers: (1) "Isokinetic Exercises"; (2) "Breathing During the Execution of Precise Motor Acts"; (3) "Investigation of the Running of Pre-School Age Children"; (4) "Al Feuerback and V. Voikin in the Shot Put"; (5) "The Influence of Anthropometric Parameters on Successful Learning in Gymnastics"; and (6) Barbell Exercises for Women Throwers. A listing of articles available from this journal is appended. (JD)

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COVER

The free throw. At play are the student teams from the U.S.A. and USSR. The game ended with Soviet sportswomen victorious.

Photo by V. Ul'yanov

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"Isokinetic Exercises"
Theory and Practice of Physical Culture, 9:64-67, 1972
A. N. Kousakin
All-Union Scientific Research Institute of Physical Culture

Many research studies substantiate the importance of general strength preparation, and in particular, specialized strength preparation in most contemporary sports (D'yachkov, 1961, 1967; Ozolin, 1962; Zatsiorsky, 1966; Kouznetsov, 1970; Verkhoshansky, 1970; Vaitsekhovsky, 1970, and others). Work with weights is now used in sports where it was once considered of no value and even harmful (sports games, track and field, swimming and so forth). With the ever increasing utilization of strength training in the preparation of athletes of different qualifications the problem of specifity of strength exercises becomes more and more acute. Therefore, the introduction of isokinetic exercises - a new means of strength preparation, different in principle from all presently used methods - merits special attention.

The essence of these exercises is in the speed of accomplishing a given exercise and not in resistance as is usually the case. In order to load the muscle isokinetically, a special mechanical device is needed. Any apparatus for isokinetic exercises ultimately represents a speed governor. The resistance of the apparatus increases with an increase in the speed of execution. When speed reaches the required level, all further attempts to increase it will cause a sharp increase in the resistance of the apparatus, proportionate to the dynamic effort applied. Isokinetic exercise ensures a maximum load on the muscles which is maintained throughout the entire movement being executed, and makes it possible to maintain a relatively constant speed of execution. Depending on the goals set forth for the exercise, the speed of execution may vary from several meters per minute to several tens of meters per second. In this way isokinetic exercises can be used for the development of slow, fast, and explosive strength.

The idea for this new method of strength exercises was developed by Perrin, a biomechanics consultant from New York, who constructed the first apparatus for isokinetic exercises in 1965. In the beginning these exercises were applied only in medical practice as physical therapy for restoration of normal muscle function. More than five years of application of these exercises in several hospitals in the United States and tests conducted on convalescent patients (Thistle, Hislop, Moffroid, Lowman and others, 1966-1967) showed their high efficiency: they caused a powerful strength increasing stress throughout the whole range of movement.

Soon after, coaches and specialists in the field of physical education became interested in this apparatus. One of the first works which prompted the application of these exercises in sports was the work of Thistle (1967). He did a study comparing the influence of isotonic, isometric and isokinetic exercises, respectively, on the workability of subjects, and the amount of maximum effort exerted by them. The

experiment was conducted 8 weeks. The results of this experiment, conducted with physically healthy people, are given in Table 1. As can be seen from this table, isokinetic exercises proved to be much more effective than the other two types of exercises which are presently used in daily sports practice.

Type of exercise and number of subjects	CHANGES	
	general workability %	maximum strength %
Isokinetic exercises (15 persons)	+35.4*	+47.2
Isotonic exercises with weights (13 persons)	+27.5	+28.6
Isometric exercises (13 persons)	+ 9.2	+13.1
Control group, not actively participating in physical activity (9 persons)	- 9.4	- 6.0

Table 1. *The "plus" sign designates an increase in results, and the "minus" sign designates a decrease in results.

Councilman, a well-known swimming authority was one of the first to start using these exercises in sport. Since 1969 he has been using them in the training of swimmers at Indiana University. This is one of the strongest teams in the U.S.A. which includes such outstanding swimmers as Spitz, Kinsella, Hall, and others. The renowned American trainer, Gambrill, who trains swimmers with world titles, such as Larsson and Fassnacht, also started to use these exercises. There is also data on the effective utilization of isokinetic exercises in throwing and weightlifting. Isokinetic exercises are now used in sports games for working out hand and leg hits, ball throws and so forth. They are also being introduced into other sports. At the present time isokinetic exercises find enthusiasts in many countries of the world.

In our country isokinetic exercises are not widely used in sports practice for the time being, however, in many research studies there is data on exercises in the concentric (overcoming resistance) and eccentric (yielding) regimes of work, which, by their nature are similar to slow isokinetic exercises (Zatsiorsky, 1966; Semenov, Chudinov, 1968; Verkhoshansky, Kouznetsov, 1970).

Let us return to the written description of isokinetic exercises. Before doing this, a clear definition of the types of muscular contraction, (tension)[1] must be given. Three basic regimes are differentiated (Verkhoshansky, 1970) as follows:

1. Isotonic - when muscle length changes, but the tension developed remains unchanged,

2. Isometric - when tension is developed with the length of the muscle unchanged,

3. Auxotonic - when with a change in muscle length there is a change in muscle tension.

In this instance isokinetic contractions act as a particular case of auxotonic contractions. For the sake of better understanding let us study only three types of muscular contractions: isotonic, isometric, and isokinetic (Thistle, 1967).

1. Isotonic contraction of the muscle occurs when resistance remains constant by an absolute quantity. The term "isotonic" is not synonymous with "dynamic." An isotonic contraction is one of several types of dynamic contractions.

2. Isometric contraction of the muscle occurs when there is no movement, i.e., it is not dynamic. In this case, an object, either fixed (immovable) or too heavy for a given group of muscles, can serve as the resistance. The resistance here will be in proportion to the effort applied to it.

3. An isokinetic contraction, as with the isotonic, is related to a dynamic contraction, i.e., it occurs with movement. However, the speed of the movement during the isokinetic contraction is held constant with the help of a special mechanical device. The resistance here is in proportion to the effort applied throughout the entire range of movement.

In order to better understand the advantages of isokinetic exercise, let us compare them with the other two types of exercise. The main disadvantage of isometric exercise is that it develops essentially static strength as when they are practiced the muscle shortens, but movement is absent. In most cases a sportsman needs to develop dynamic rather than static strength.

Isotonic exercises are executed with movement and therefore develop primarily dynamic strength. At the same time these exercises have their own disadvantage - they do not ensure a uniform, and in particular, maximum loading of the

---

[1]In respect to use of the terms "contraction," "concentric contraction," "eccentric contraction," "isotonic" and a number of others, no uniform opinion among scientists has been worked out,

muscles throughout the whole amplitude of movement. As the resistance during the isotonic regime of work always remains constant, it cannot exceed the level which a given muscle or a group of muscles is able to overcome in the weakest, most unfavorable (biomechanically) segment of the movement. This has been proven by the works of many Soviet and foreign scientists (Hansen, 1923; Carpenter, Fenn, 1938; Clark, 1950; Kosilov, 1965, and others).

Besides the biomechanical factor, there exist many physiological factors which limit the load in the isotonic regime of work. For example, the relationship between muscle length and tension (Hansen, 1923; Fenn, 1938; Wilkie, 1950, and others). All this lowers the effectiveness of isotonic exercises to a considerable degree as the muscles experience a maximum load only in a small portion of the movement trajectory, when at the same time in other sections they do not work at full strength, because the load is limited to a weight which the muscles are able to overcome at the most unfavorable (from a biomechanical point of view) position of the bone levers.

The chief aim of exercises for development of strength, irrespective of a specific method or use of a mechanical device, is to create such resistance, which could load the muscle to a maximum, regardless of the various biomechanical or physiological factors involved. As can be observed, isotonic exercises do not fully satisfy this condition.

This condition, however, is satisfied by isokinetic exercises or, as they are also called, exercises with an adjustable load, which are able to produce a maximum load on the muscles throughout the entire range of movement. As was already mentioned above, for execution of isokinetic exercises a special mechanical device is needed. The first apparatus, constructed by Perrin, was an electro-mechanical device and is still used in medical practice.

However, this apparatus is expensive, cumbersome, and can only be used in laboratory conditions.

At the end of 1968, Fons constructed a new type of apparatus for execution of isokinetic exercises. He used a centrifugal governor as a means of maintaining a given speed of the movement. This comparatively inexpensive apparatus, known as the "mini-gym," is not large and is designed for a greater number of exercises than the "cybex exerciser." Now there are at least ten models of the "mini-gym." All these models have a retractable device which enables the cord to return very rapidly to its initial position for another repetition. Most models have needle indicators for measuring the applied effort. There is one model of the "mini-gym" which traces a curve of the effort applied.

Tests conducted with isokinetic exercises, together with the experiences in practical application revealed the following basic advantages.

1. An increase in effectiveness of strength exercises enables one to achieve a significant increase in strength and general workability during a much shorter period of time as compared to other methods of strength preparation which are now in use.

2. A greater quality "workout" of the muscles and inclusion of a greater number of muscle fibers (motor units) into the work results in a greater absolute increase in muscular strength.

3. Time spent on training is significantly decreased.

4. Specificity of training is increased because of the ability to set up one or another speed of isokinetic contractions with the use of the apparatus.

5. Strength is markedly increased among sportsmen having long experience in exercising regularly with weights.

6. Muscle pain is sharply decreased during strength preparation workouts.

7. In view of the light weight and small overall dimensions of the apparatus, training can be done outside of the gymnasium or stadium.

8. The apparatus for execution of isokinetic exercises can at the same time be used as a dynamometer.

However, thorough and detailed verification of data on isokinetic exercises must be made prior to adopting them for wide use. It is no secret to anyone that many articles printed in Western sports magazines are of a frankly commercial and advertising nature. For example, Dennis, an English specialist in the sports field, conceded that all research related to sports is closely watched by numerous groups of businessmen eager to pick up on any novelty which can bring them money through mass production of sporting implements or equipment.

Isokinetic exercises are principally a new method of developing strength. As with any other innovation, especially when it concerns the effect on the human body, these exercises, before getting a "clean bill of health," must undergo deep theoretical and practical analysis. This is an unusual and a much stronger physiological stimulant than all presently applied methods acting on human muscles. During an isotonic contraction the muscle is loaded with maximum effort within a second; during the isokinetic regime the contraction with maximum effort takes place during the entire execution of the exercise. This will naturally result in higher demands on the body, because here we are dealing with a concentrated physical and mental load. If applied unskillfully and immoderately, isokinetic exercise could lead to instances of physical and emotional breakdown.

In conclusion, I would like to emphasize that working out the principles of isokinetic exercises will be an obvious

achievement for sports science and a qualified step towards a more conscious and controlled direction of the training process. At present, it is difficult to say what role and what place isokinetic exercise will occupy in the total volume of general and specialized strength preparation. The effectiveness of isokinetic exercises is being tested in practice everywhere and the methods for using them are constantly improving. It is possible that these exercises will become part of a great system of exercises with programmed speed, when the speed requirements will be set in relation to the laws of speed changes in a given motor model. In time answers will be given to all of these questions. Only one thing is clear, this new and effective means of action on the human muscular system merits serious attention and that in the nearest future isokinetic exercises will find their lawful place in the system of general and specialized strength preparation.

* * * * * * *

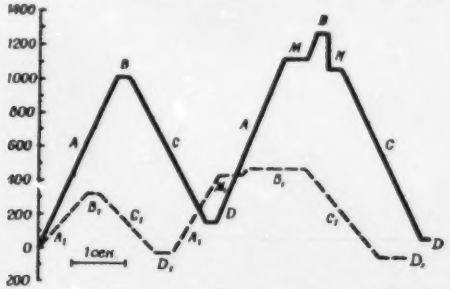
Doctoral student: I'm learning about jumping.

"Breathing During the Execution of
Precise Motor Acts"
Theory and Practice of Physical Culture, 4:36-38, 1973
I. P. Blokhin, U. I. Portnikh and A. M. Khutov
(Condensed)

The relationship between breathing and movement over a long period of training has been well established. However, the relationship between the breathing and motor act during execution of precise movement (in this case, the free throw in basketball) has not been previously studied.

Investigated in this study was the breathing of basketball players before the free throw, during the shot, and after the shot, with the use of a spirograph. The players executed 3-5 throws: senior ranked players used the "one hand from the shoulder" shot and beginning players "two hands from the chest." In all, there were seven beginning athletes and eleven first class players. The beginning players had several months of training and the ranked players, 7-10 years.

Results of the study can be seen in the graph. [Raw data tables, findings and discussion are omitted - ed.]



Before the throw During the throw

Time and volume changes in the structure of the breathing cycle in qualified (solid line) and beginning (broken line) basketball players before the throw and during the time of execution of the free throw. A and A_1 - phase of inspiration, B and B_1 - pause after inspiration, C and C_1 - phase of expiration, D and D_1 - pause after expiration, M and M_1 - breath holding on inspiration and N - breath holding on expiration.

The conclusions of the study were as follows:

1. Execution of precise motor acts brings forth curtailment of breathing mainly because of an increase in the inspiratory interval, the phase of expiration and the appearance of breath holding periods. This restructure of the breathing cycle in beginning players is more sharply expressed than in the qualified players.

2. The inspiratory and expiratory volumes increase during execution of the free throw in which the expiratory volume is greater than the inspiratory.

3. The free throw is carried out with a fixed position of the chest cage, as a rule, in the inspiratory half cycle of the breathing act.

4. The level of breath holding during the shot in qualified basketball players is close to the volume of the preceding inspiration and in beginners, definitely more.

5. Expedient (taking into consideration general and individual factors) presentation of breathing and strengthening this skill in training can be a reserve for increasing the preciseness of execution of the free throw by basketball players.

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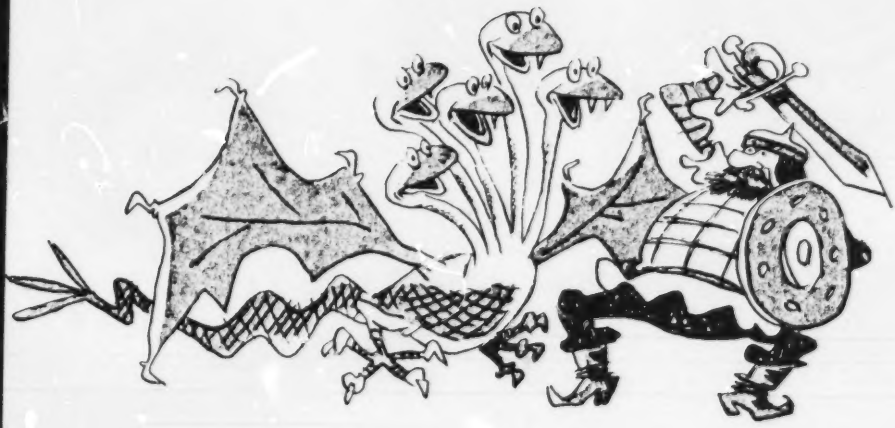

"Investigation of the Running of Pre-School Age Children"
Theory and Practice of Physical Culture 2:40-41, 1973
E. S. Vilchkovsky, S. A. Oreshchuk and V. B. Shpitalny

The utilization of contemporary methods of investigating basic movements (walking, running) of pre-school age children makes it possible to more deeply and fully study their structure, give a foundation for methods and will give clear directions for utilization of these movements in movement games and in physical education lessons in the nurseries and kindergartens. The study of running of pre-school children has been undertaken by Bernshtein (1940), Levi-Gorinevskaya and Bikova (1948), Popova (1940), Tamuridi (1947) and others.

In this study we tested 1200 pre-school children from the ages of 3-7 from Kharkov and Kiev. Studied were: the dynamics and growth of speed of running in the 10, 20, and 30 meter distances; coordination of arm and leg movements in running; time of the support and non-support position of the body; and length and frequency of strides.

In order to record several biomechanical characteristics of the running movements (time of the support and flight phases, the vertically composed support reaction and vertically composed acceleration of the center of mass) a battery of tensiometric methods were employed. A stop watch was used to measure time and a quality evaluation of the arm and leg coordination was carried out by visual observation and according to film data, taken with a speed of 32 frames/second.

In this research we determined that in all the children tested (from 3 to 7 years of age), there is a flight phase in running. With an increase in age the duration of this phase increases and the support phase decreases. Towards the seventh year of life, there is an almost identical duration of time of the support and flight phases in the child's running. According to duration and the relationship between them (support time -- 0.125 sec.; flight time -- 0.120 sec.; and relationship - 1:0.96) children seven years of age approach adult indices (adults who do not participate in sport). Vertical effort in support in children of this age reaches two times their own weight which is characteristic for the run of an adult person.

In the pre-school childs' run with a high start the increase in running speed occurs gradually, and maximum speed, depending upon the age of the child, is reached in the 3rd-6th second. At maximum speed, which they maintain for 1-2 seconds, the greatest length and frequency of stride is observed. According to running speed, boys of all age groups out-do the girls and only in the 4-5th year do their results level off. The greatest increase in running speed for all the distances is noticed in the period from 4-5 years of age.

Study of the dynamics of running speed allows us to decide more precisely the important question of choosing the optimal distance for running exercises in the practice of

physical education with children 3-7 years of age. Therefore, the 15m distance can be recommended for 3 year olds, the 20m distance for 4-5 year olds and the 30m distance for 6-7 year old children. Running these distances does not bring forth any pathological changes in the organism of the child and can be recommended for all practically healthy children.

Investigation of the essentials of the run of pre-school children showed that toward the seventh year of age they possess strong running skill, which by its own form and several kinematic and dynamic characteristics (time of support and flight, stride frequency and vertical support effort reaction) approach the results of juveniles and adults. Further development of running skill occurs in the following years of life as a result of natural growth and physical development.

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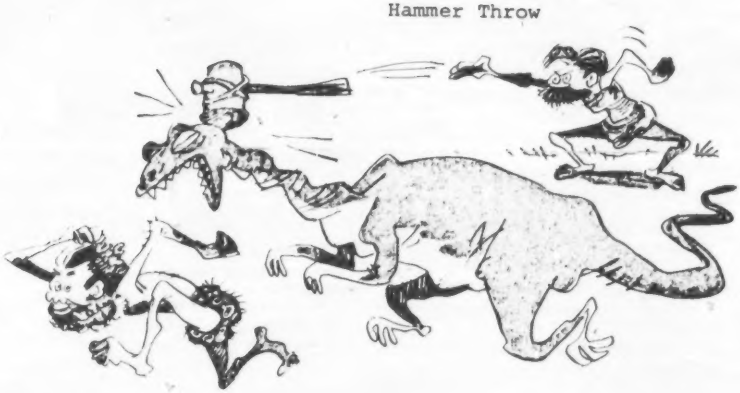
Hammer Throw



Cross Country

"Al Feuerbach and V. Voikin in the Shot Put"
Track and Field, 12:20-21, 1973
Commentary by A. Ivanov
Cinematograms by R. Maksimov

In Moscow, June, 1973, the American world record holder, Allan Feuerbach, appeared at the international meet sponsored by the newspaper "Pravda." In the main competition he threw the shot 20.91 meters. Presented here is the cinematogram of this throw. It should be noted that Feuerbach went into competition after an eighteen hour flight and appeared at the stadium early in the morning, straight from the airport in order to qualify. The result shown in the qualifying round was 20.61 m.

For comparison of several basic moments in shot put technique, the cinematogram of one of our leaders in this event - V. Voikin is presented (his best throw in this meet was 20.20 m.) The cinematogram of Voikin was not chosen by chance as the technique of both of these athletes is very complex according to style. But why is the best recorded by Feuerbach equal to 21.82 m and Voikin at 20.56 m?

The height of Feuerbach is equal to 185 cm and weight, 111 kg. The height of Voikin is 192 cm and weight is 125 kg. Feuerbach significantly exceeds Voikin according to the level of physical strength. However, when it comes to technique, Voikin does not lag behind the world record holder in practically anything, but none the less, there are moments where Feuerbach has advantages.

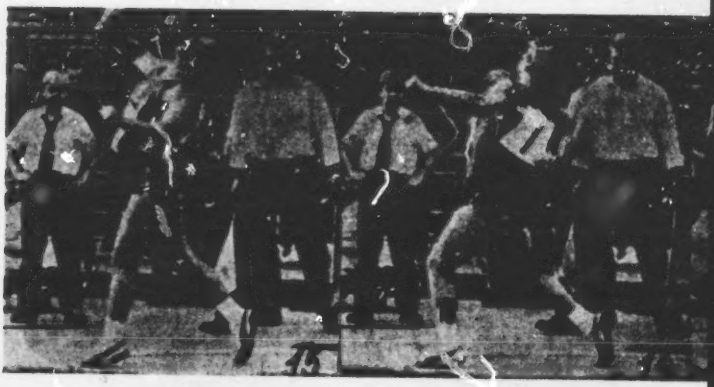
The world record holder executes the swing of the left leg the same as all shot putters, after which he "crouches" into a low stance (frame 2) and begins the swing of the left leg (frames 3-7). Characteristic for the American athlete is the good "gathering" (frames 3-5) and execution of the low skip from the heel of the right foot (frame 7).

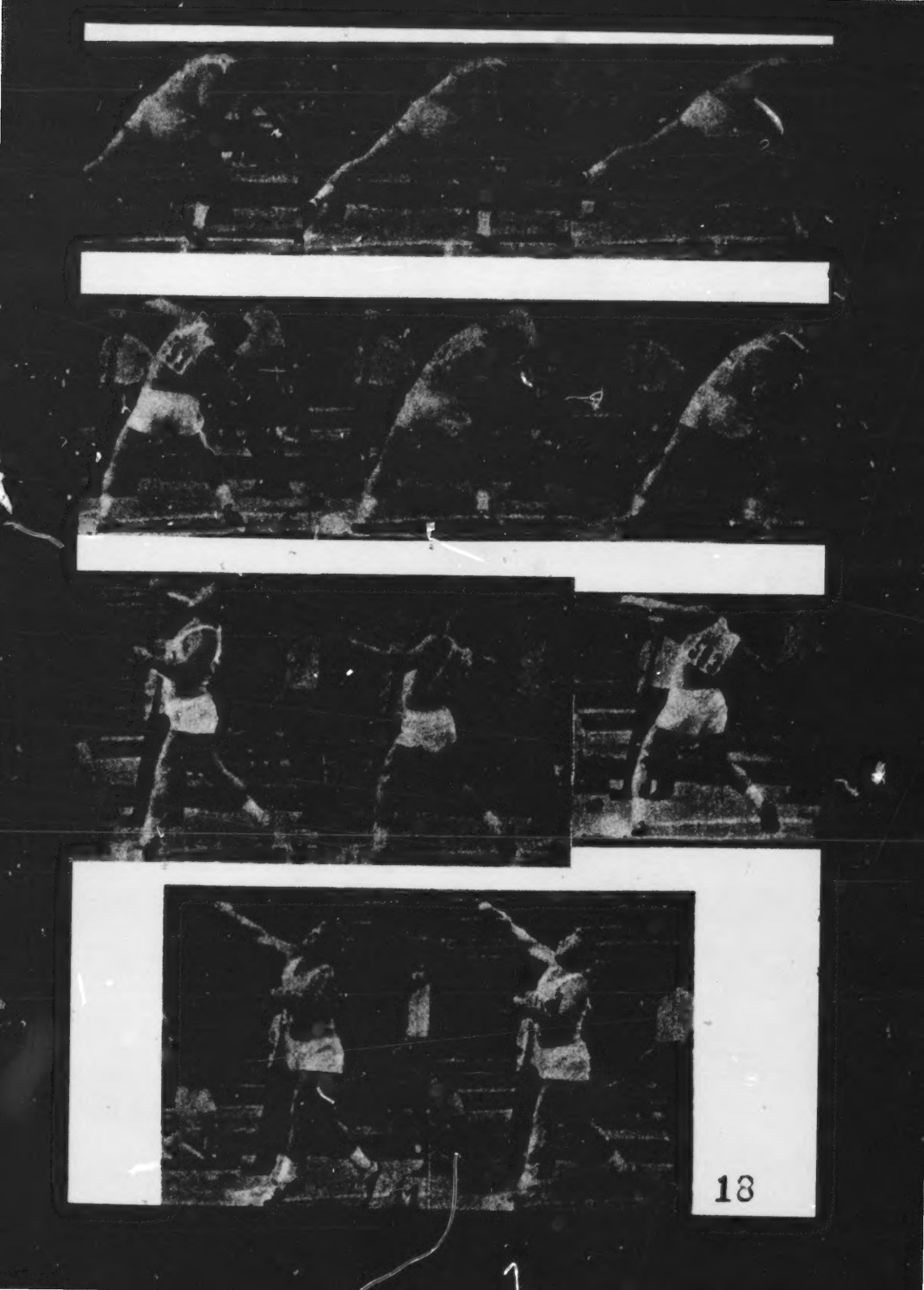
Analogous movements are also seen in Voikin (frame 7a), but direct your attention to frame 9 (non-support phase). Ease and simplicity characterize the movement of Feuerbach but some "academism" is inherent in Voikin.

Placement of the leg (frames 10-11) after the skip. Some technical advantages by Feuerbach can be seen here. He lands on bent legs and turns the left foot around in the direction of the throw which brings forth maximum tension of the hip joint muscles.

In taking the shot "on himself" (frames 12-14) Feuerbach more actively executes the rotational-progressive movement of the body, but Voikin hurries somewhat in extending the trunk which lowers the effectiveness of the leg work in the concluding phase of the throw.

Both sportsmen demonstrate outstanding holding of the left side of the body [trunk]. In this, Feuerbach has a more





powerful and longer influence on the shot, rotating the right side of the body around the imaginary axis of rotation running through the left side of the body. This significantly increases the acceleration of the shot in the concluding phase of the put (frames 15-17). Further on, (frames 16-17), there is effective work of the hand (which is not present in Voikin) and a change of the legs which help the athlete stay in the ring.

* * * * * * *

Now look closely at how you should put the shot.

"The Influence of Anthropometric Parameters on Successful Learning in Gymnastics[1]"
Theory and Practice of Physical Culture, 3:50-52, 1973
E. U. Rozin

The nature of body composition and body proportions of sportsmen has been the subject of attention of anthropologists, physicians and educators for many years. Scientists who studied characteristic features of body structure of sportsmen in various specializations agreed that anthropometric differences exist between these athletes. In most cases, these differences have been explained by the specific influence of particular exercises in the particular sport. Both in Soviet and in foreign literature little information about the morphological prerequisite for choosing a particular sports specialization and about the influence of different anthropometric parameters on achieving success in the sport can be found.

For the theory and practice of sport, particularly in choosing a sport, we must not ignore the importance of, for instance, height in basketball, body mass in weightlifting and in the shot put, arm length of javelin throwers, hand size in swimmers, etc. Scientists studying the physical development of adult gymnasts have stated that weight and height of adult gymnasts are considerably less than those of sportsmen in other specializations. Our research on the physical development of gymnasts, from a 10 year old novice to an adult master of sport, was conducted in cooperation with scientists Kozlova and Lyassotovich from the Laboratory of Sport Orientation of the National Research Institute under the supervision of Groshenkov. It was established that gymnasts of all age groups have less weight and height. This fact can be explained by the specific demand in gymnastics for great relative strength which is closely coorelated with body height and weight.

In studying the development of muscular strength in gymnasts (in relation to their age and qualifications), we observed that in many cases, even if the gymnasts had identical relative strength, they displayed it differently. We surmised that the reasons for this difference, besides the physiological factors, are chiefly biodynamic in nature, and thus dependent upon anthropometric parameters, which make it easier or more difficult to execute certain stunts involving strength. To investigate these factors a specific study was carried out. One of the aims of this study was to determine the degree of influence of basic anthropometric parameters on the learning of a stunt dependent upon static strength. Ten, thirteen year old gymnasts participated in the yearly experiment in which different pedagogical observations and methods were applied (anthropometry, polydynamometry, control exercises and mathematical calculations).

In order to test the above hypothesis, one of the more difficult static strength stunts was used - the iron cross -

[1]The article deals with only one aspect of this major problem.

support of the body on the rings with the arms abducted. According to the laws of mechanics, the iron cross depends upon several components: weight of the gymnast, arm length (lever arm length) and circumference of the tensed shoulder.[1] It also depends upon the biological factor of strength able to counteract the weight of the gymnast during execution of this particular exercise.

Having data on each of these parameters enables one to calculate the muscle force required by every gymnast to hold the iron cross.

In order to establish formulas we proceeded from the following assumptions (see figure 1):

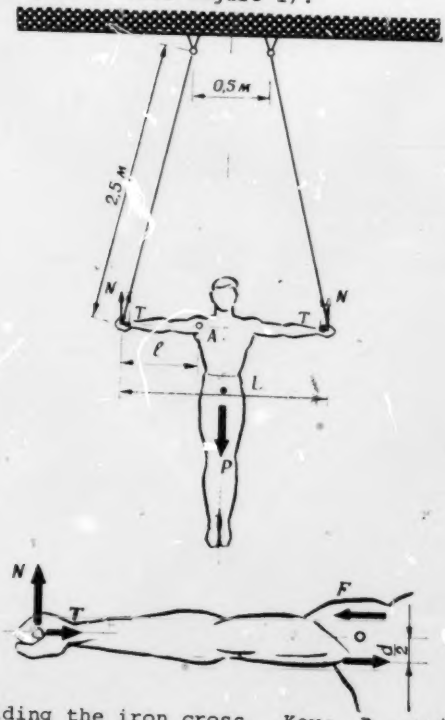


Figure 1. Holding the iron cross. Key: P - weight of the gymnast, N, T - support reaction, L - total arm span, ℓ - arm length, d - diameter of the tensed shoulder, F - muscle force needed to hold the iron cross.

[1]We included this factor into our calculations because of the correlation between absolute muscle strength of the shoulder and the circumference of the tensed shoulder. In masters of sport it was (n = 20, r = 0.42 - 0.53 with p at 5 - 0.1%) and in 13 year old gymnasts (n = 30, r = 0.43 - 0.44 with p at 5 - 0.1%).

1. Force N has a moment about the shoulder joint and force T does not have a moment since the direction of the force is through the joint.

$MA^1 = N\ell$. Force $N = \frac{P}{2}$, then $MA = \frac{P\ell}{2}$

Force N is determined from $\Sigma Y = 0$, that is, $N + N + P = 0$.

2. Moment MA is counterbalanced by the created muscular effort.

$MA = \frac{Fd}{2}$ then $\frac{P\ell}{2} = \frac{Fd}{2}$ or $F = P\frac{\ell}{d}$.

Anthropometric dimensions and the muscle force required to maintain the body in the iron cross posture are given in Table 1 for master of sport gymnasts and in Table 2 for the young gymnasts training in class II. Subject Sh-o (force 111.7 kgcm) and subject D-v (force 124 kgcm) have theoretically the most suitable conditions for executing the iron cross. Subjects S-v (force 155 kgcm) and I-kh (force 138 kgcm) have the poorest conditions for executing the cross. Practical results have confirmed this. The first two gymnasts can easily perform this exercise regardless of either the place in which the skill appears during the routine, or the order of the event.

Name	Weight, Kg.	Arm length, cm.	Circumference of the tensed shoulder	Muscular effort needed to hold the iron cross
D-v	68.5	70.5	39.0	124.0
S-v	67.5	82.5	36.0	155.0
S-n	70.5	74.7	39.5	132.5
I-kh	63.0	75.6	34.5	138.5
V-n	63.5	75.1	36.0	132.0
L-c	65.0	75.0	36.5	133.5
K-v	64.0	74.3	36.0	132.1
Sh-o	63.0	71.6	38.5	117.1
K-o	62.5	75.0	36.0	130.6
K-v	63.6	75.2	35.5	134.7

Table 1. Calculated parameters for masters of sport.

Results of a rank correlation analysis showed that a close relationship exists between the amount of muscle effort needed to maintain the iron cross position and the maximum time that the gymnast can hold this position measured in seconds ($r = 0.89$, with p at 0.1%).

[1] Moment of force about point A.

From Table 2 it can be seen that the amount of muscle force required to maintain the iron cross position by young gymnasts is significantly less than for masters; not withstanding the fact that the strongest of the Moscow gymnasts was in this age group. None of the gymnasts in this age group were able to perform this skill, although a serious effort to learn it was made in the experiment.

Name	Weight, Kg.	Arm length, cm.	Circumference of the tensed shoulder	Muscular effort needed to hold the iron cross
P-n	36.3	57.3	24.0	86.0
G-v	41.2	64.1	27.0	97.1
P-v	31.7	56.7	25.5	70.4
S-v	35.0	54.5	24.0	79.5
O-v	40.2	65.0	26.0	100.0
A-v	37.9	57.5	25.0	85.8
Z-n	48.0	67.8	26.0	125.1
R-v	35.0	63.0	24.5	90.0
Kh-n	41.2	65.1	28.5	94.1
D-v	33.3	62.4	24.0	86.5

Table 2. Calculated parameters for 13 year old gymnasts.

Further analysis showed that the mean relationship between expended muscular effort on one arm and body weight in masters of sport and in young gymnasts is considerably difference. (See Table 3.)

Subject P-v ($F = 70$ kgcm; $\frac{F}{p} = 2.22$) in the young gymnasts' group had the most suitable conditions for executing the iron cross. However, the relationship between his expended muscle force and his body weight is somewhat higher than the analogous ratio of master of sport I-ch who still has to improve his iron cross considerably. It is obvious that the relationship between arm length and body weight during the period of growth is one of the reasons why we so seldom see a 16 year old youth perform this stunt. Comparison of the required muscular effort and its relationship to weight in masters of sport and young gymnasts makes it possible to make a prognosis of successful future mastery of this exercise for subjects P-m, S-m, and Kh-m.

The mathematical calculations show that a gymnast with relatively long arms needs to expend significantly more effort

in order to maintain his body in the required posture. Keeping this in mind we can now understand the striving of gymnasts to hold the iron cross with a "deep grip" or to "pump the cross," with a shortened lever with support from the forearm in the radio-carpal joint.

Master of Sport	$\frac{F}{p}$	Young Gymnast	$\frac{F}{p}$
D-v	1.81	P-n	2.38
S-v	2.30	G-v	2.35
S-n	1.91	P-v	2.22
I-kh	2.20	S-v	2.25
V-n	2.01	A-v	2.30
L-i	2.05	O-v	2.50
K-v	2.06	Z-n	2.60
Sh-o	1.86	R-v	2.57
K-o	2.10	Kh-n	2.28
K-v	2.10	D-v	2.50
		D-v	

Table 3. Relationship between muscle force required to hold iron cross position and body weight.

When working with young gymnasts one has to bear in mind not only the theoretical amount of muscle force required to perform the cross, but also the actual amount of strength that the gymnast is capable of developing in order to execute this skill.

The information received makes it possible to evaluate the level of preparation of the gymnast for execution of the iron cross. In order to do this, one has to take into account the distance between the shoulder joint and the support (forearm, radio-carpal joint) during a 3 second stay in the iron cross position.

$$J^1 = \frac{F \text{ required} - F \text{ actual}}{F \text{ required}} \cdot 100;$$ rearranging the above we get:

$$J = 1 - \frac{F \text{ actual}}{F \text{ required}} \cdot 100$$ which means that

$$J = 1 - \frac{\ell \text{ actual}}{\ell} \cdot 100.$$

Frequently in practical work on the iron cross, the gradual increase in arm angle method is used. When executing the iron cross with a shortened lever as well as with the shoulders raised in relation to the grip (support), a smaller

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[1]The level of preparation for execution of the iron cross in %.

moment is required. The magnitude of the moment will depend upon the distance between the shoulders and the support (h). This is shown by the following calculations:

$$MA = N\ell - Th \text{ or } F\frac{d}{2} = N\ell - Th = \frac{P}{2}\ell - Th$$

From here $F = \frac{P\ell}{d} - T\frac{2h}{d}$; then as $T = \frac{P}{2tgd}$ at tg $2 \approx 4.0$

$$T = \frac{P}{8} \text{ and } F = \frac{P\ell}{d} - \frac{Ph}{4d}.$$

Clearly $h < \ell$, supposing that h = 10 cm in the case of subject D-v (Table 1).

$$F = 124 - \frac{68.5 \times 10}{4.39} = 124 - 4.39 = 119.6 \text{ kgcm } (96.5\%).$$

In the case of subject S-v:

$$F = 155 - \frac{67.5 \times 10}{4.36} = 155 - 4.7 = 150.3 \text{ kgcm } (97.0\%).$$

This example proves that when the shoulders of these gymnasts are 10 cm above the horizontal position, the force required to maintain the position is reduced by 4 kg for each arm. It also can be seen that in this particular case, the length of the gymnast's arms does not make any difference.

Thus, we can conclude by saying that in gymnastics, certain anthropometric parameters, such as height, weight, and limb length, have a considerable influence on the execution of complex strength stunts. These factors make the conditions to master these stunts easier or more difficult. A gymnast with relatively long arms has certain disadvantages in this event, althought he has advantages in executing stunts on the side horse because of his naturally higher landings and in executing stunts on the apparatus which require swings.

When selecting children for participation in gymnastics it is necessary to take into account not only their height and weight, but also their body proportions, and the relationship between limb and trunk length. Mathematical calculations concerning particular anthropometric parameters make it possible to give a prognosis of successful mastery of the iron cross by young gymnasts and to plan and control their preparation in order to execute this particular stunt.

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"Barbell Exercises for Women Throwers"
Track and Field, 12:18-19, 1973
Z. Sinitskiy

Up to this tine, many coaches and athletes use the three classical weightlifting events for strength and speed-strength preparation. Of course this is tempting, for the very strong people - weightlifters, and everyone else wants to develop his strength as fast as possible.

In 1926, I was middleweight champion of the USSR and naturally, carried away with track and field throwing continued barbell exercises during the winter. With time as I went into coaching, I began to think of using barbell exercises that would develop all muscle groups in the winter period of training for track and field athletes. Used were turns and bends with the barbell on the shoulders, squats and jumps with the barbell and others, but basically, the press, snatch and jerk were executed. We were the first in the world to begin using barbell exercises for women. This was in the winter of 1934-5. Results in the summer were improved and no ill effects were observed. From that time on barbell exercises began to be used more freely and fearlessly by all sportswomen and now women lift sufficiently great weights.

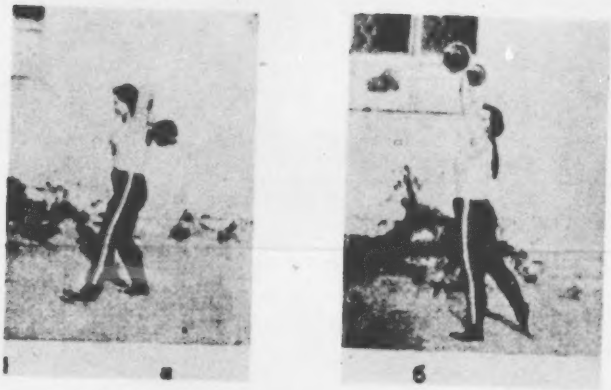
Even in the 50's I thought that the classical barbell exercises for track and field athletes were unfit. This was due to the fact that at the moment of the greatest effort in the snatch and jerk, the weightlifter lowers his body and sits under the barbell, whereas at the same time in throwers (even in runners and jumpers) the final effort begins with a lifting of the body upward and forward.

In sports practice over the latter years everyone is striving to use, for the development of strength, such exercises where maximum effort appears in the same position as in the sports event, - in this case in the final effort in the javelin throw. Such a "conjugation" allows for simultaneous resolution of physical and technical preparation.

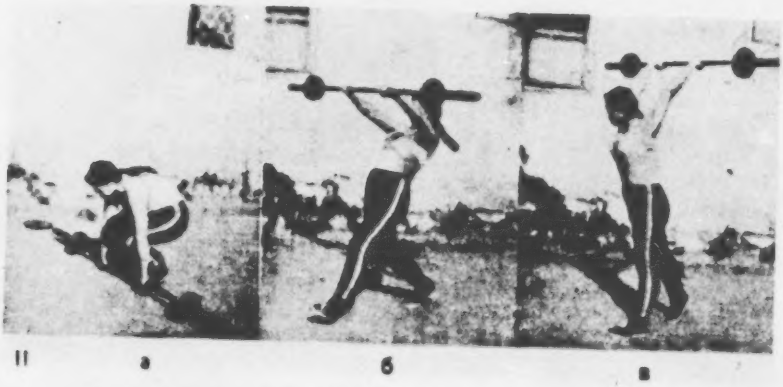
The final effort in all throws begins with work of the legs and this should be remembered from the very first steps of training a thrower. It is especially difficult to execute leg work in the javelin throw as it is tied in with great running speed. If you don't teach the thrower from the very beginning that all exercises, tied in with releasing the javelin "begin with the legs" then the final effort is reduced to only movement of one arm.

Below are specialized barbell exercises which have been used by throwers in our group for many years.

Exercise 1. Barbell behind the head, arms bent, left leg forward and right leg slightly bent. With quick extension of the right leg and arms the barbell is carried in front of the head with straight arms and body weight is transferred to the left leg. (Photo 1)



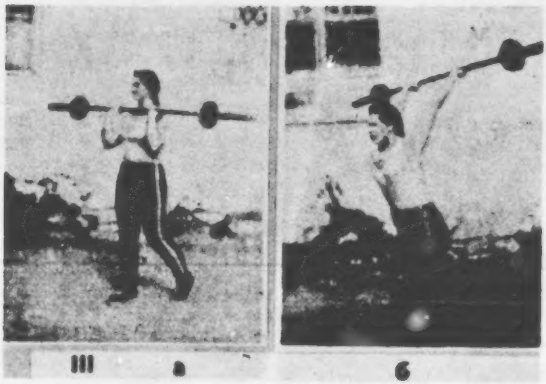
Exercise 2. From a squat position quickly straighten the legs with a step forward with the left leg. The barbell is carried forward - upward and backward with straight arms. The trunk drops forward. Body weight is on the left leg. (Photo 2)



Exercise 3. Barbell is on the chest and the left leg is back. With a slightly bent and quickly extended right leg take a step forward and press (almost a snap back) the barbell over the head as the body falls forward. Body weight is on the left leg. (Photo 3).

This exercise is executed in succession, beginning with a weight of 25-30 kg, (5 kg are added in each set), repeated 5-6 times with 3-4 sets.

A few preliminary words must be said about barbell exercises with one arm. We throw missiles (with the exception of the hammer) with one arm, but develop strength in both arms simultaneously and with this strengthen the shoulder girdle somewhat. I am convinced that it is very necessary to exercise with weights and with one arm.



III а б

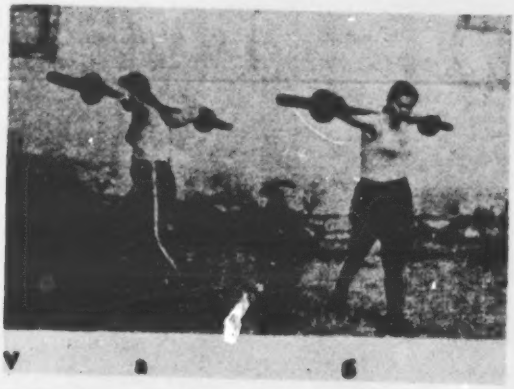
Exercise 4. Squat and take the barbell with one hand in the center of the bar. Quickly extend the legs with a step forward with the left leg. The barbell, as in Exercise 2, is carried forward - upward and backward. It is necessary to learn this exercise with a small weight. (Photo 4)

IV а б в

Exercise 5. Squat, taking the barbell in the center of the bar with one hand with a "palm up" grip. In straightening the legs and trunk, left the barbell to the right shoulder and turn it to the right pointing the elbow to the right side of the pelvic girdle. With a "springy" squat, snap the barbell upward with work of the legs, trunk and arm. In no case should you do a supplementary squat in order to shorten the travel of the barbell as weightlifters do in the jerk with both arms.

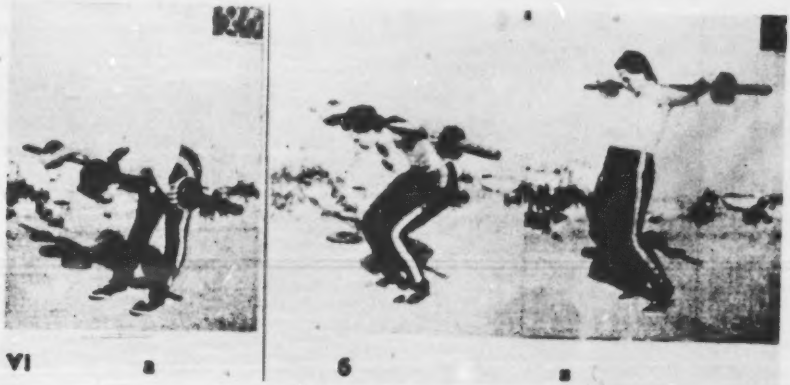
Exercise 6. The same as Exercise 5. Press the barbell with straightening of the arm and trunk toss. This exercise is executed in the first 2-3 months of the preparatory period.

Exercise 7. Barbell is on the shoulders, feet are placed wider than the shoulders, and the hands hold the plates, not the bar. Do right and left turns. Second variant: in turning the trunk with the barbell simultaneously squat and with quick extension of the legs turn to the opposite side. Make a toss - thigh hit. The same again but to the opposite side. (Photo 5)



V a б

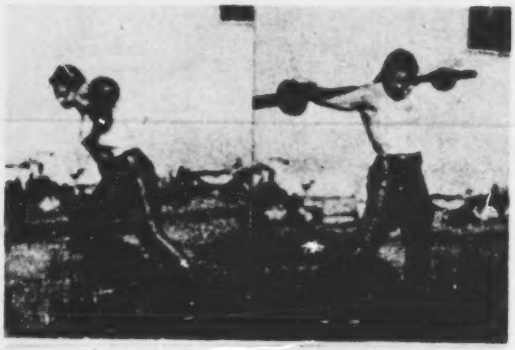
Exercise 8. The starting position is the same as in the preceding exercise. Lean the trunk forward and down with the legs straight and then quickly straighten. Second variant: lean forward and downward with the legs slightly bent. Then quickly extend the legs moving forward as much as possible and straightening. (Photo 6)



VI a б

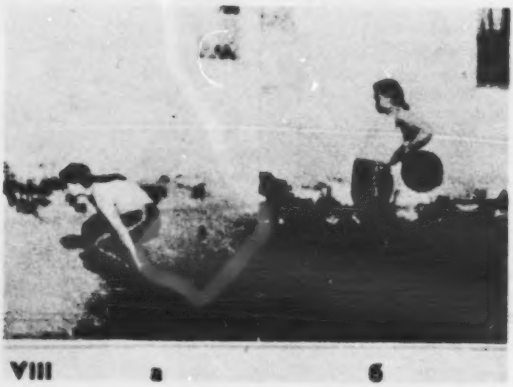
Exercise 9. The starting position is the same as in the preceding exercise. With a slight squat extend the legs in a spring like manner and go into a "squat" [the same as in the snatch, feet on the same line]. After the jump change the position of the feet as well as the tempo of doing the exercise.

Exercise 10. Alternate squating on the right and left leg with sharp turns of the pelvic girdle during the extension phase as in the final effort in the throw. The leg being extended rotates on the ball of the foot to allow for further forward movement of the pelvic girdle. (Photo 7)



VII а б

Exercise 11. Standing in front of the barbell squat and grab the bar with both hands. Quickly extend the legs and in rising up on the toes push the pelvic girdle forward. Arms are bent and the bar does not touch the body. (Photo 8)



VIII а б

Exercise 12. Barbell is lifted upward on straight arms over the head. The right hand holds the bar in a "palm-up" grip and the legs are placed wider than the shoulders. Bend the right leg and sharply extend it carrying the pelvic girdle forward and to the left as in the final effort during the throw.

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